ICES
CIEM

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Spain

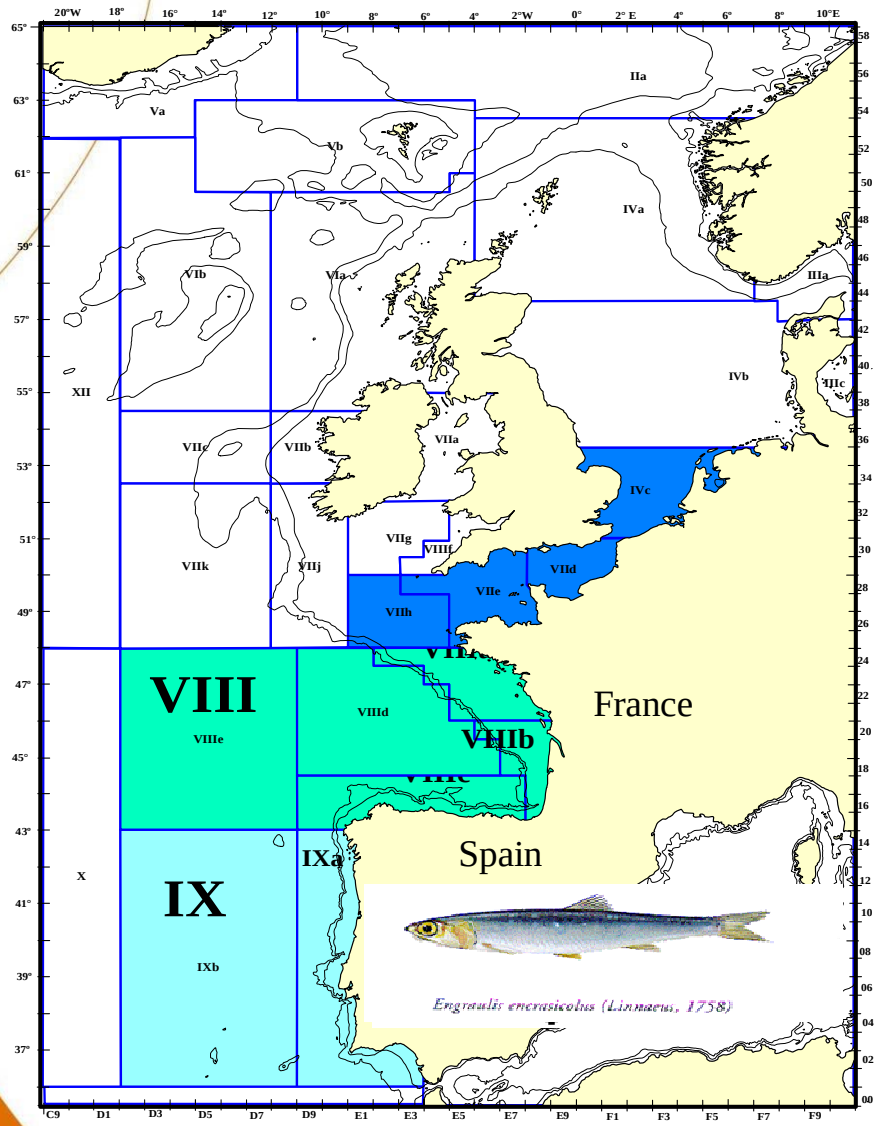
Validation of age determination from Otoliths for Bay of Biscay anchovy

Uriarte A.[1], Rico I. [1], Villamor B. [2], Duhamel E. [3], Dueñas C. [2], Aldanondo N. [1], Cotano, N. [1]

1- AZTI, 2- IEO, 3 - IFREMER

azti
tecnalia

ANCHOVY in Bay of Biscay



Anchovy: Short living species
Fast growth
Full maturity at age 1
Few Age Classes (max 4 y.o.)

High Natural Mortality
Fast decay of Year classes /
Continuous renovation of the
Population

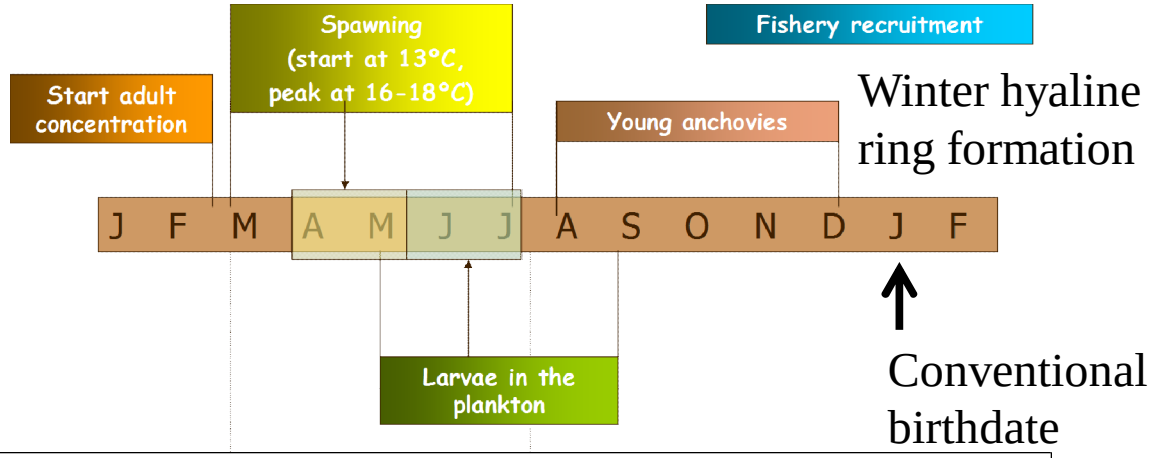
INTRODUCTION & OBJECTIVES

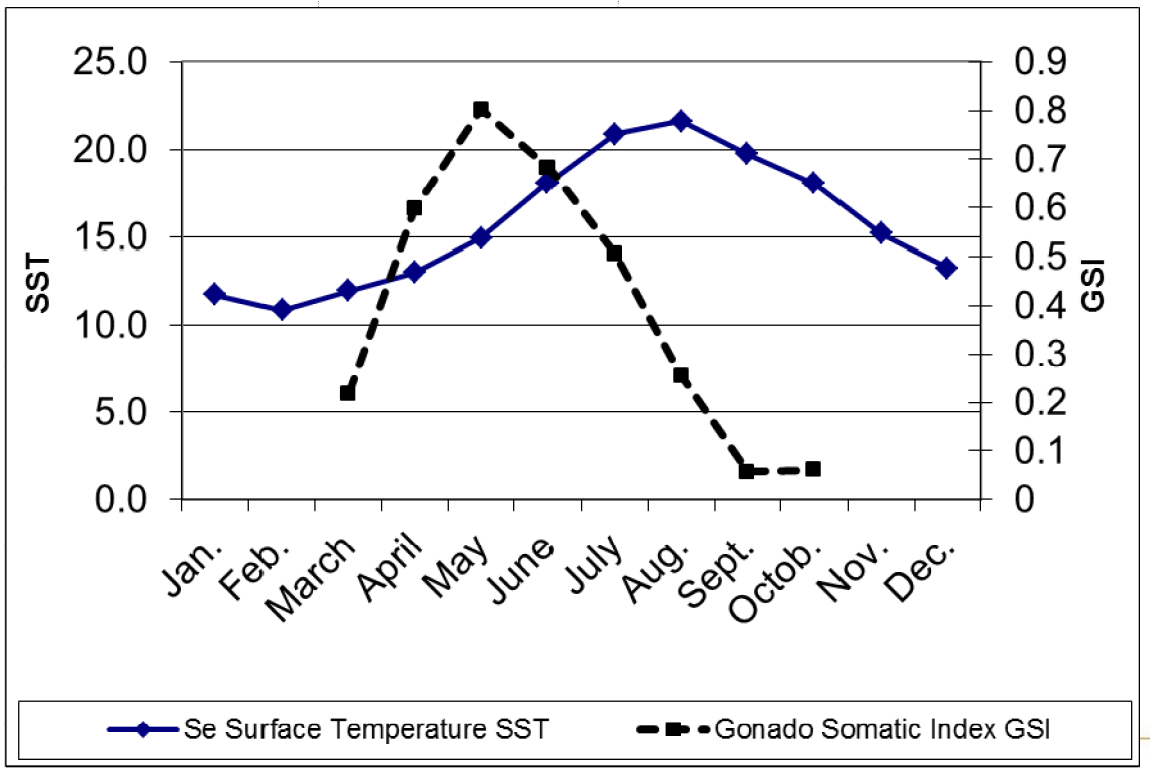
- Accurate Age determination is basic for the study of Population dynamics and for assessments
  - Current assessment based on two age groups Age 1 and Age 2+ (Ibaibarriaga et al. 2008;2011)

- Validation of the Age determination from otoliths was stablished in late eighties and early nineties at AZTI (Uriarte ms.) being improved with discussion during exchanges and workshops.
  - Presented in several workshops (1998 / 2002 /2006 / 2009) for anchovy age reading in Southeast Europe

- **OBJECTIVES of this presentation**
  - Summarize the Age Validation originally carried out for anchovy in BoB
  - Posterior (later) verification of the method up 2014
  - Current method of age determination (practice, prior knowledge and difficulties)
  - Summary of the annual growth in length

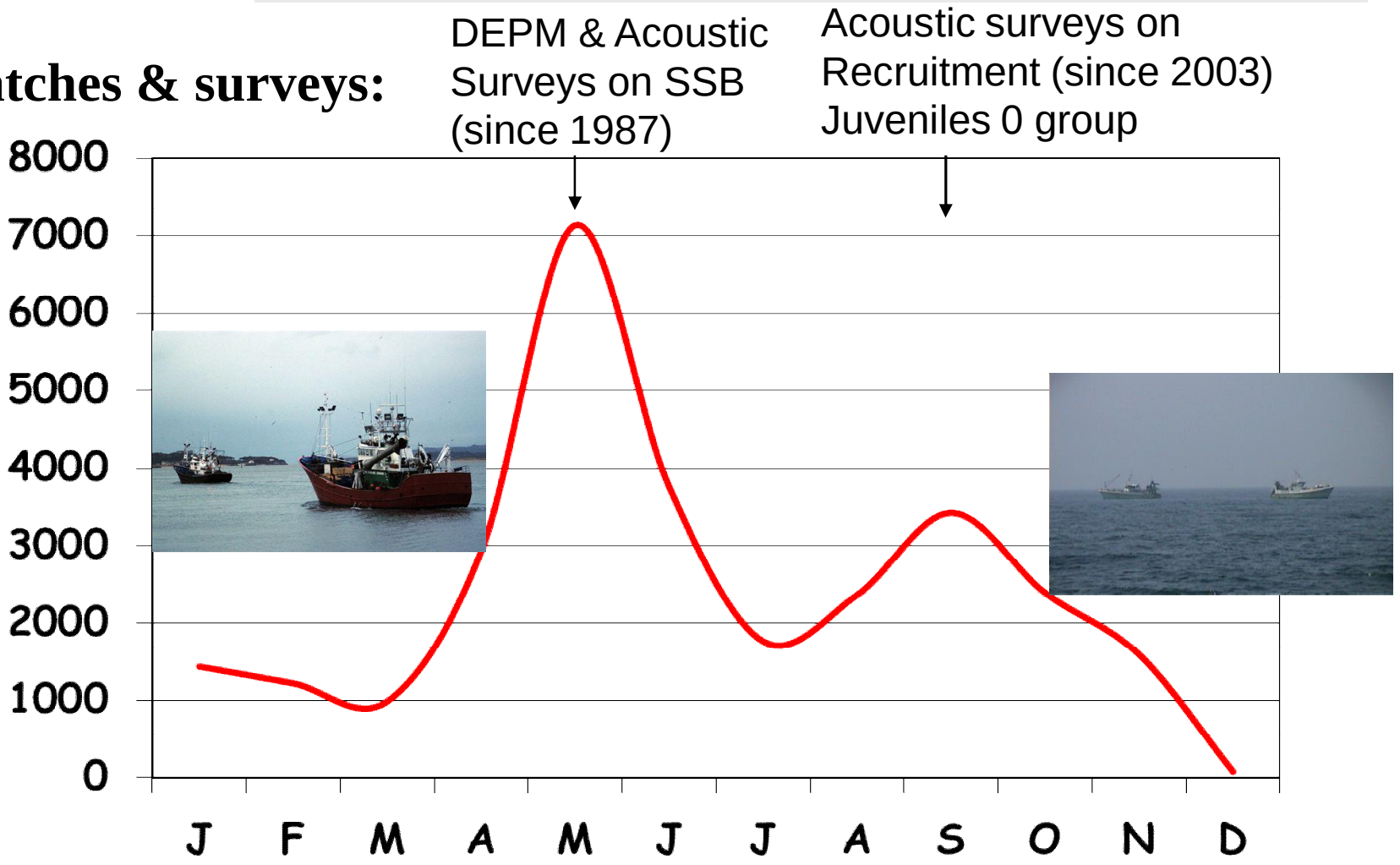
Anchovy Life cycle





The fishery and monitoring system

Catches & surveys:



METHODS

- Original Validation:
  - Monitoring of the Progression of strong year classes both in catches and surveys: The 1982 and 1989 year classes
  - Marginal Increment formation throughout the year by age classes

- Material:
  - Biological sampling (with otoliths) between 1984-2014
    - Extra original analysis on the subset 1984 – 1992 : 233 samples (7533 otoliths)

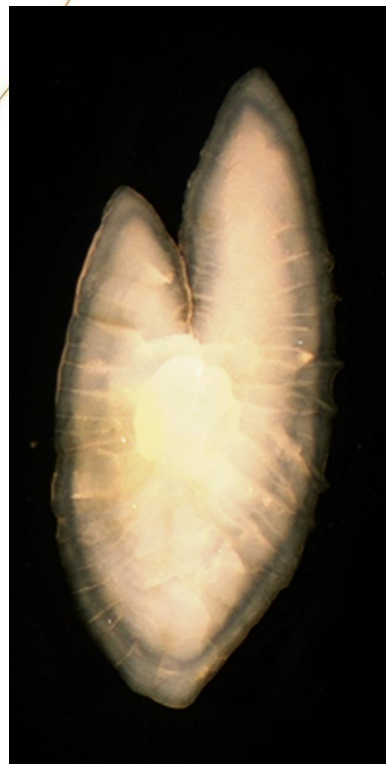
	Months												
Otoliths	1	2	3	4	5	6	7	8	9	10	11	12	Total
Age 0	0	0	0	0	0	0	0	1	95	259	327	78	760
Age 1	87	0	435	541	1048	908	308	177	242	6	16	6	3774
Age 2	6	0	205	483	805	375	132	61	25	5	11	0	2108
Age 3+	0	0	149	271	266	116	69	1	17	0	2	0	891
Totals	93	0	789	1295	2119	1399	509	240	379	270	356	84	7533
Samples	3	0	22	40	64	40	17	11	12	9	12	3	233

  - Surveys for SSB and Population estimates 1983-2014 (Acoustic and DEPM)
    - And the Juveniles acoustic survey started in 2003

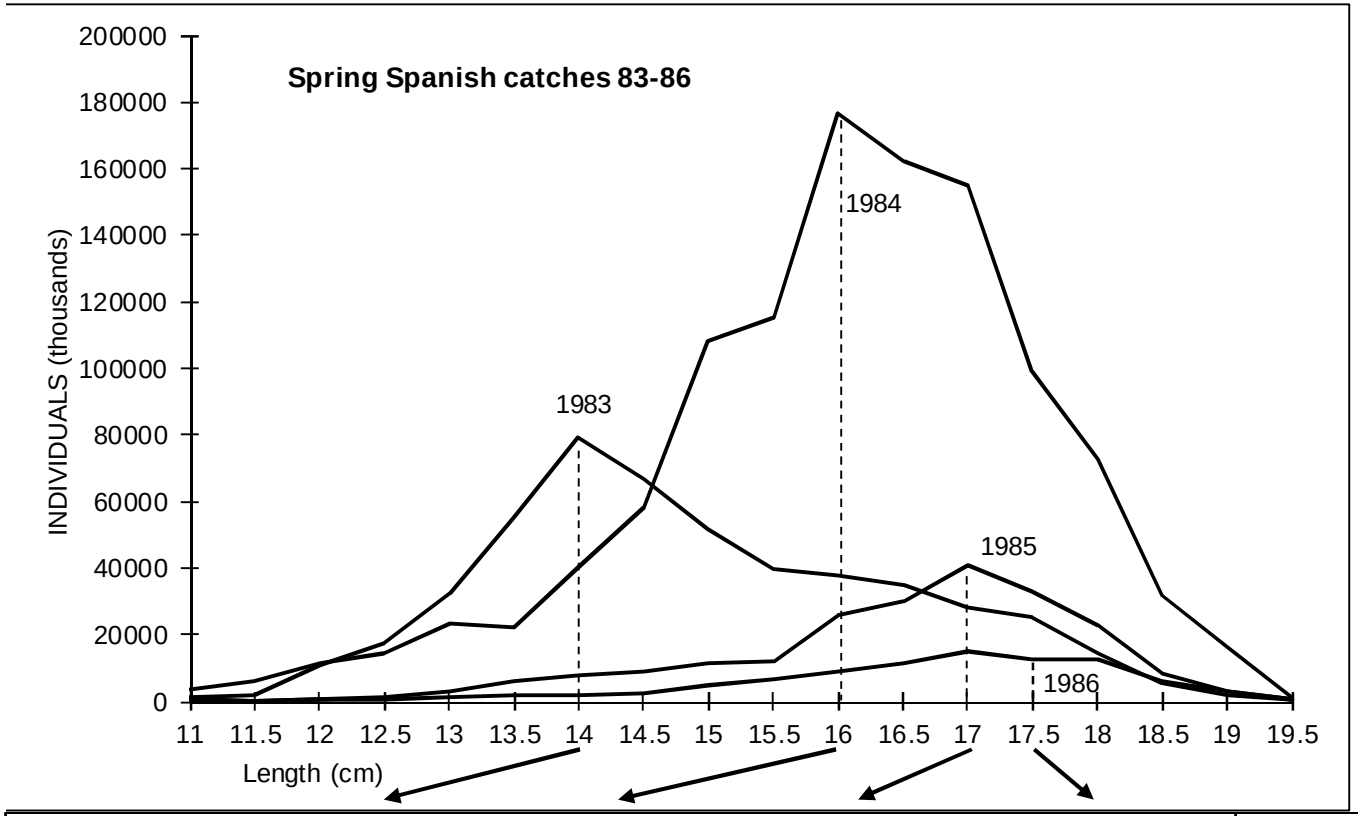
  - Length distribution of catches and age compositions with the proposed method

- Later verifications (complete series): Correlation between sucessive age classes abundances in catches and population estimates.

Typical Otolith types in Spring (April + May)

Type I	Type II	Type III	Type IV
			
Single annulus + Opaque edge On// Ow	Single annulus + Very Wide opaque band + Hialine edge Hn/ Hw	Two annulus + Wide opaque band + Hialine edge Hn/ Hw	Three annulus + Wide opaque band + Hialine edge Hn/ Hw

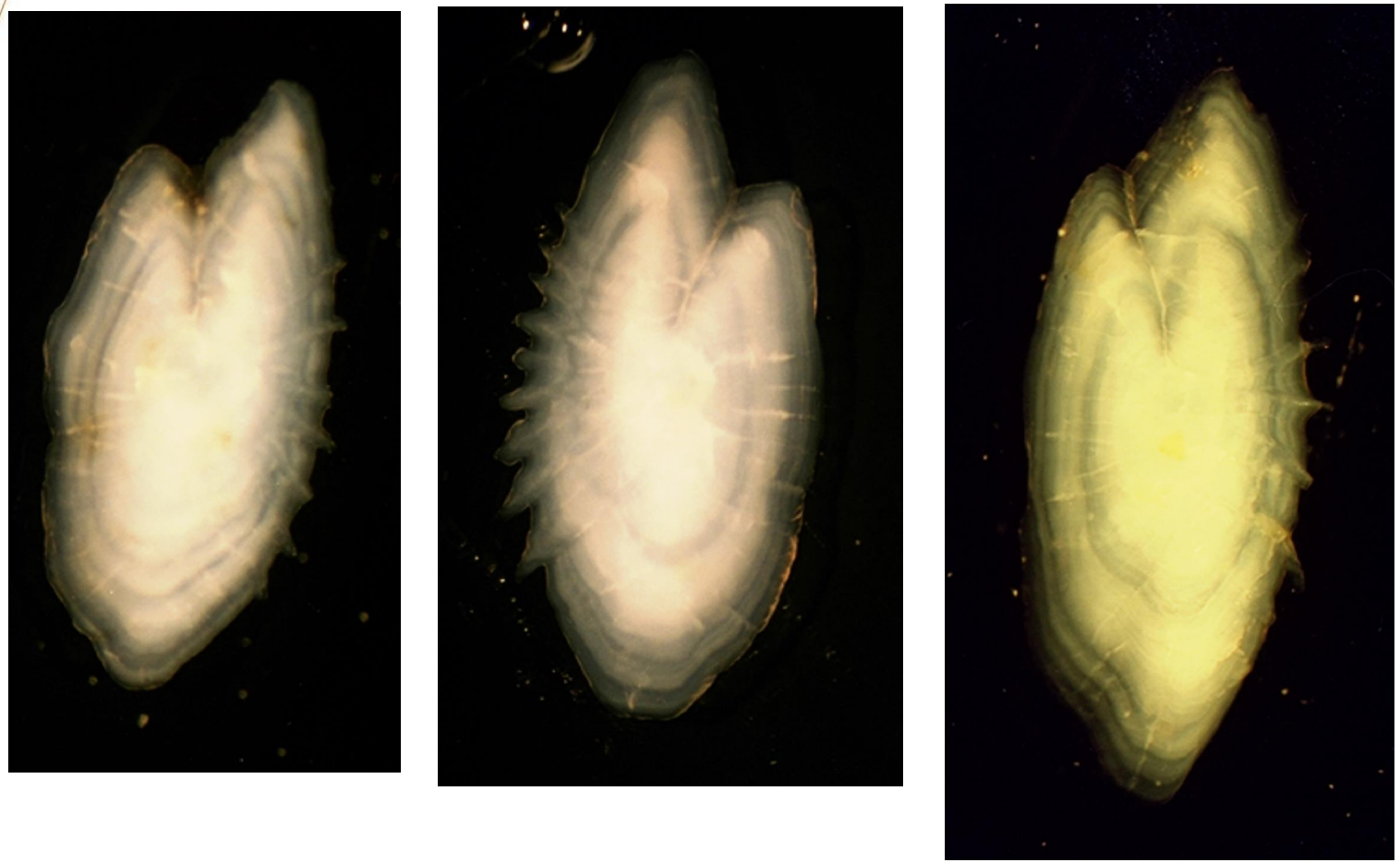
Validation 1: Progression of the 1982 cohort in Catches



Otoliths	Type I	Type II	Type III	Type IV	Total
1983 (*)	*64.4%*	*29.7%*	*5.9%*	*(*)*	*100%*
1984	12.8%	78.0%	8.8%	0.4%	100%
1985	11.8%	32.0%	54.9%	1.3%	100%
1986	17.6%	32.3%	26.3%	23.8%	100%
Conclusion	Age 1	Age 2	Age 3	Age 4	0

(*) IN 1983 There was no biological sampling and proportions by ages were inferred from length distributions (Uriarte & Astudillo 1987) with a 3+

The Old fishes from the 1982 Cohort: A Clear Growth Pattern



Typical otoliths of ages 3 (1985), 4 (86) and 5 (87) at spring time:

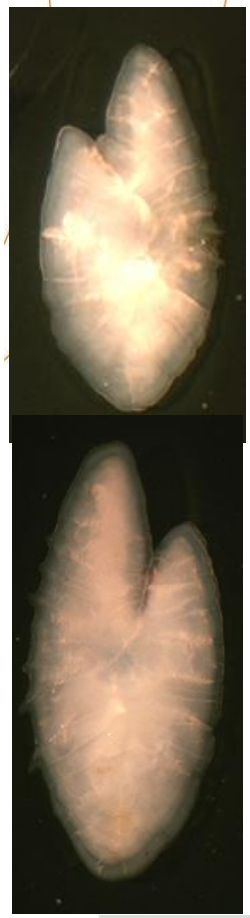
➔ Readers should know the expected annual growth pattern by ages (and most likely checks)

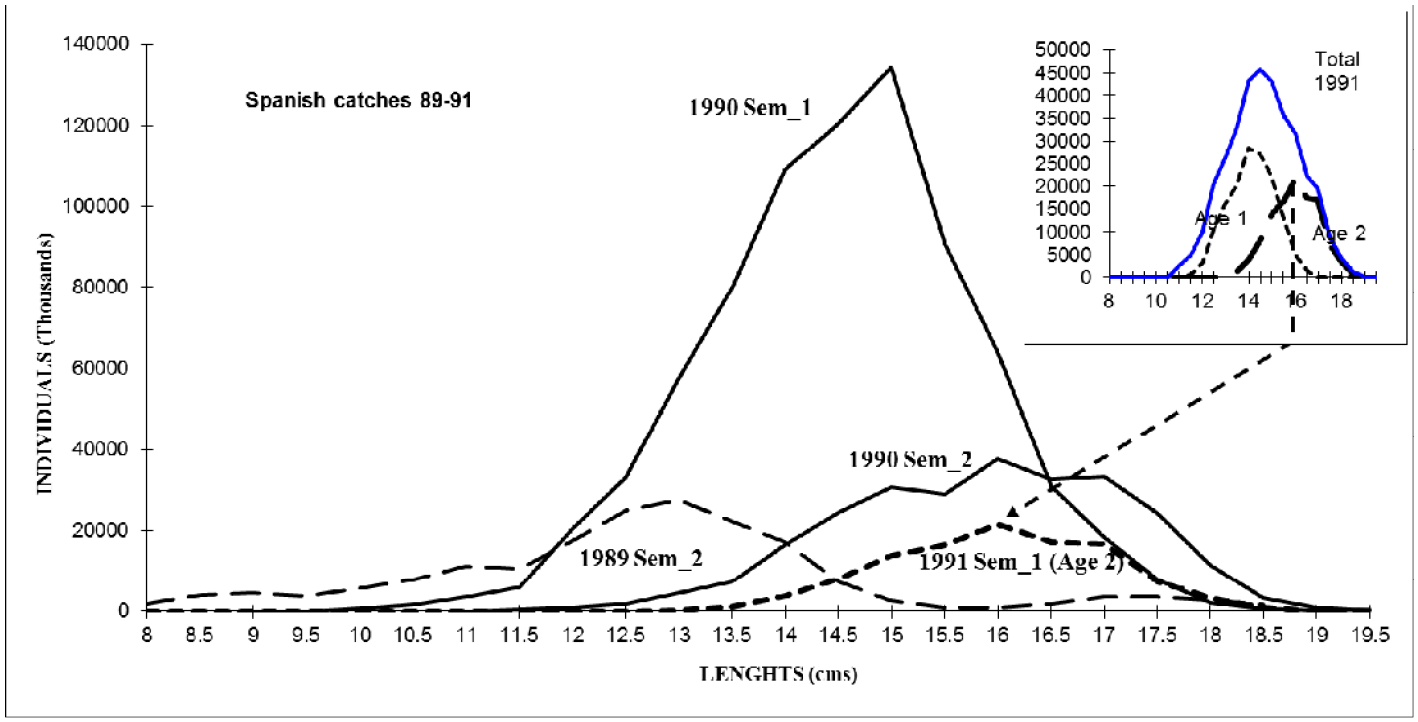
Verifying : Most recent Year Class (2010)

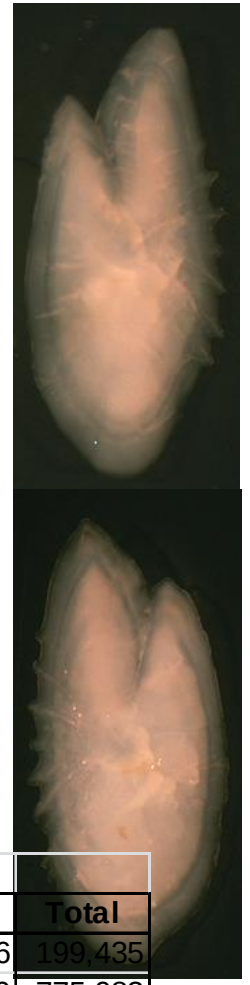
09/2010 04/2011 04/2012 04/2013 04/2014

➔ Similar growth pattern observed in recent year classes

Validation 2: Seasonal Progression of the 1989 cohort in Catches (from age 0 to 2)





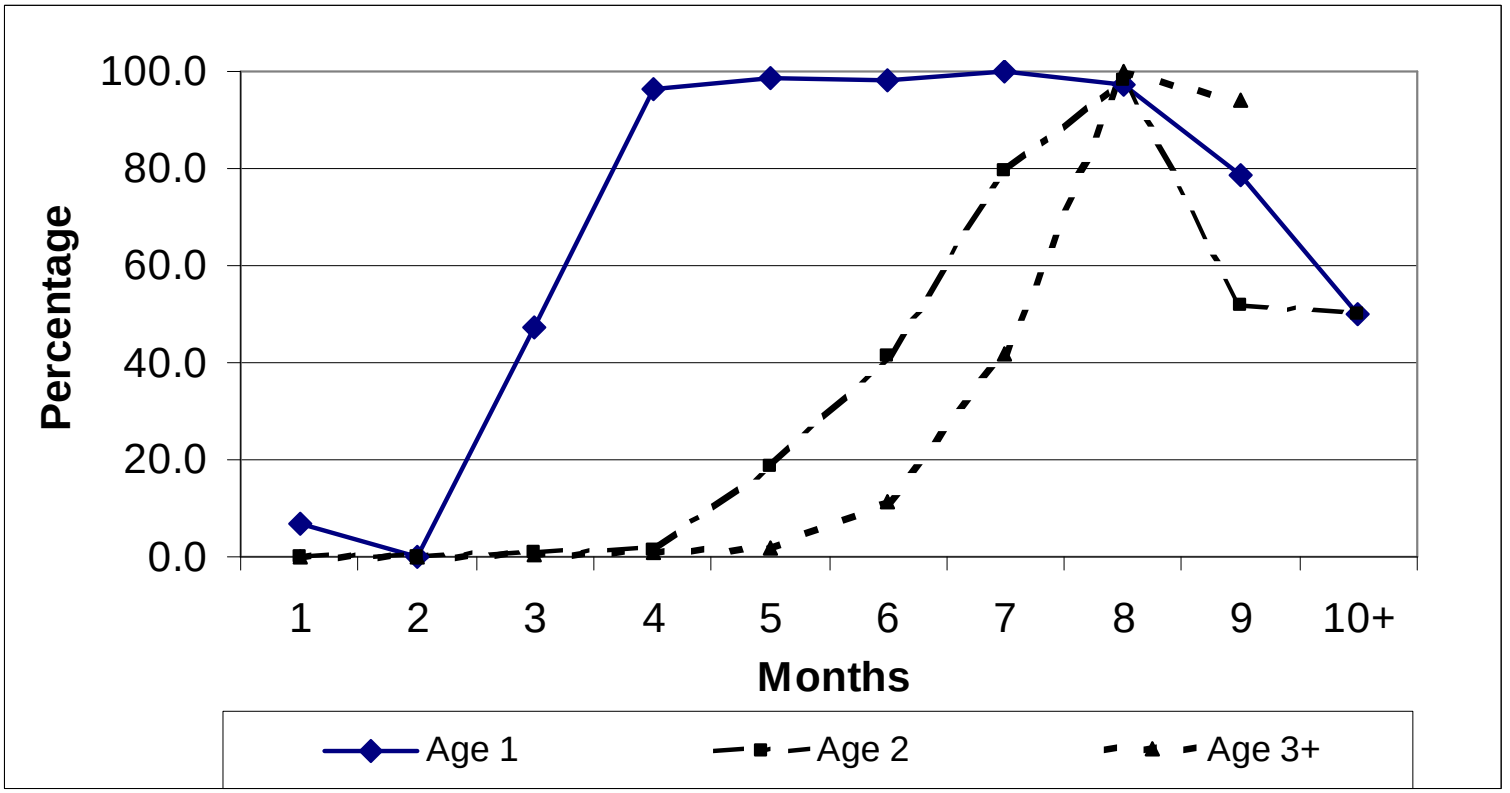


Semester 1 (Sem_1) = 1st half of the year / Sem 2 = 2nd half

➔ Maximum growth in summer time

	French Catches by semestres						Spanish Catches by semestres				
Year	Semestre	Age 0	Age 1	Age 2	Age 3	Total	Age 0	Age 1	Age 2	Age 3	Total
1989	Semestre 2	5,282	13,919	1,290	0	20,492	174,803	13,165	9,481	1,986	199,435
1990	Semestre 1	0	127,949	12,216	36	140,200	0	719,678	47,266	8,139	775,083
1990	Semestre 2	4,985	283,669	32,795	0	321,449	11,999	234,021	43,204	4,999	294,222
1991	Semestre 1	0	113,191	171,293	26,522	311,007	0	210,686	139,327	2,657	352,670

Opaque Edge formation by ages



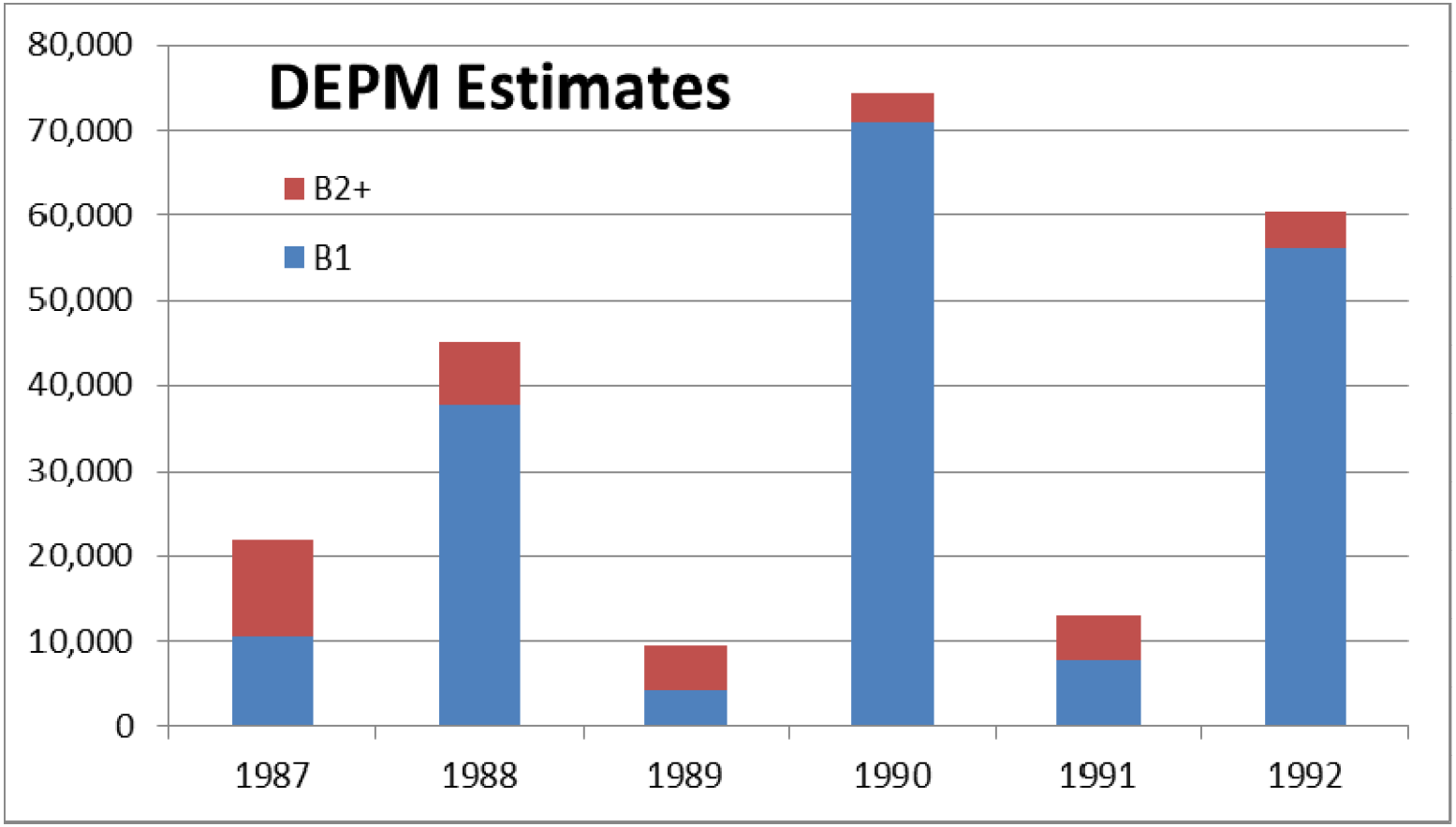
Percentages of otoliths by ages showing an opaque edge

➔ The younger the fish the sooner resumes growth

in Spring age 1 edge is opaque, while it is hyaline for older ages

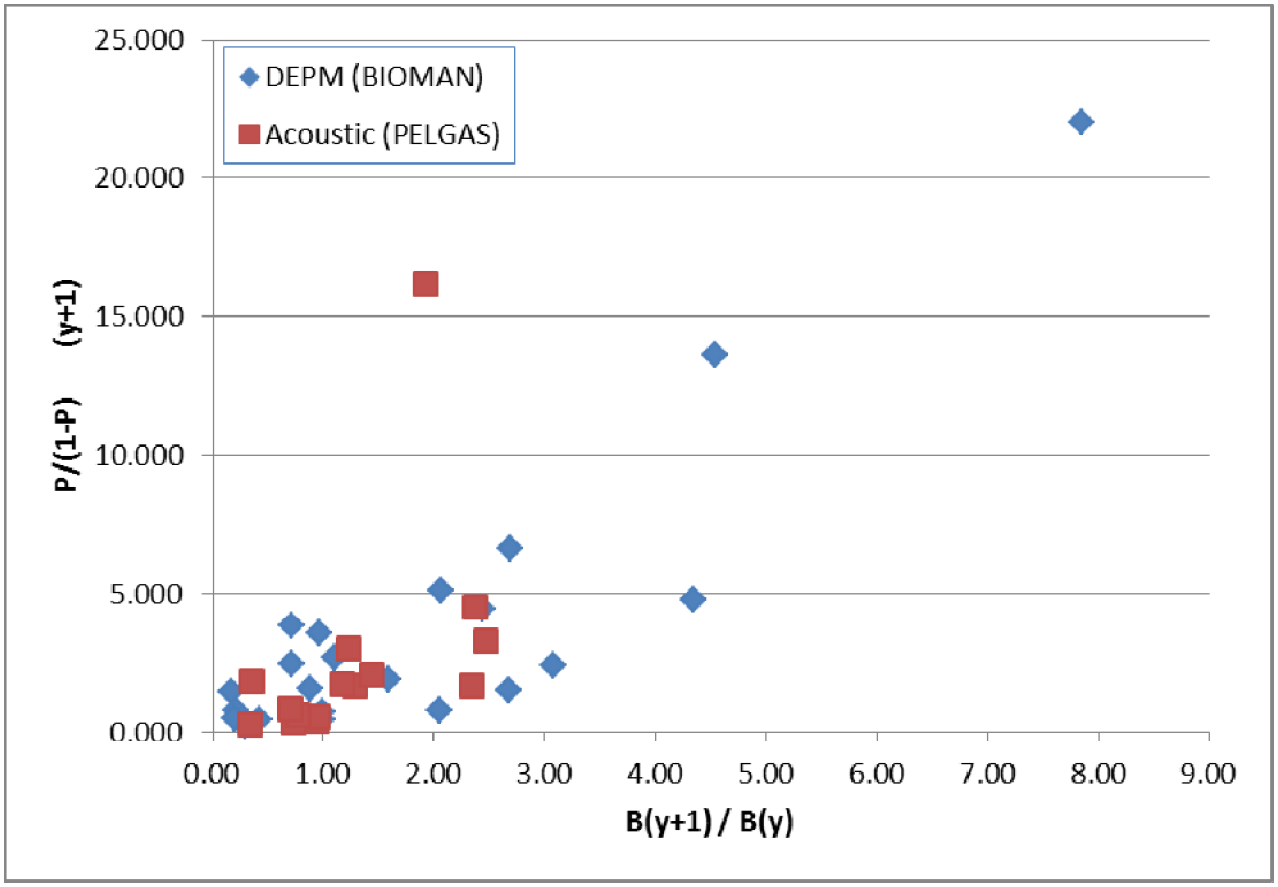
➔ Readers should know a priori the monthly expected type of edge by ages

Validation 3: Increases of biomasses in Spring Surveys due to strong recruitments



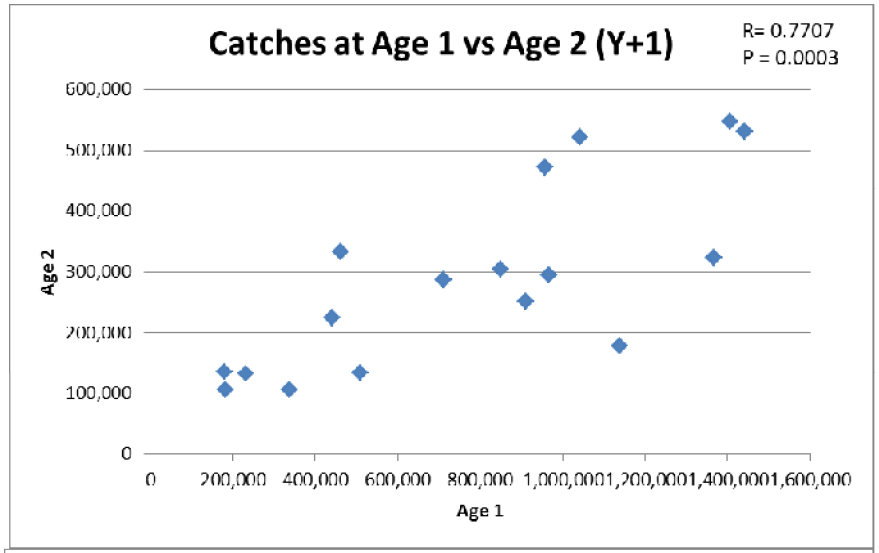
➔ Good determinations of ages 1 and 2+

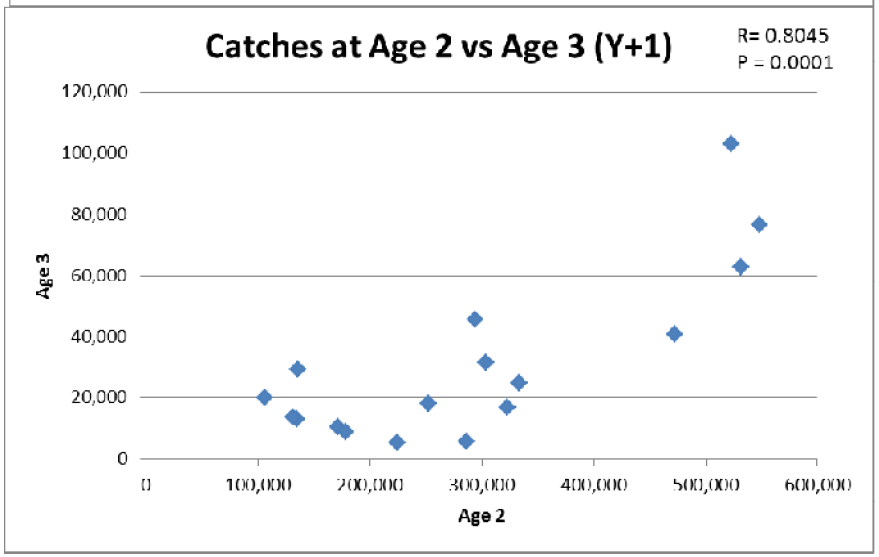
Verifying with complete survey series: Historical relative changes in Biomass over Percentages at age 1



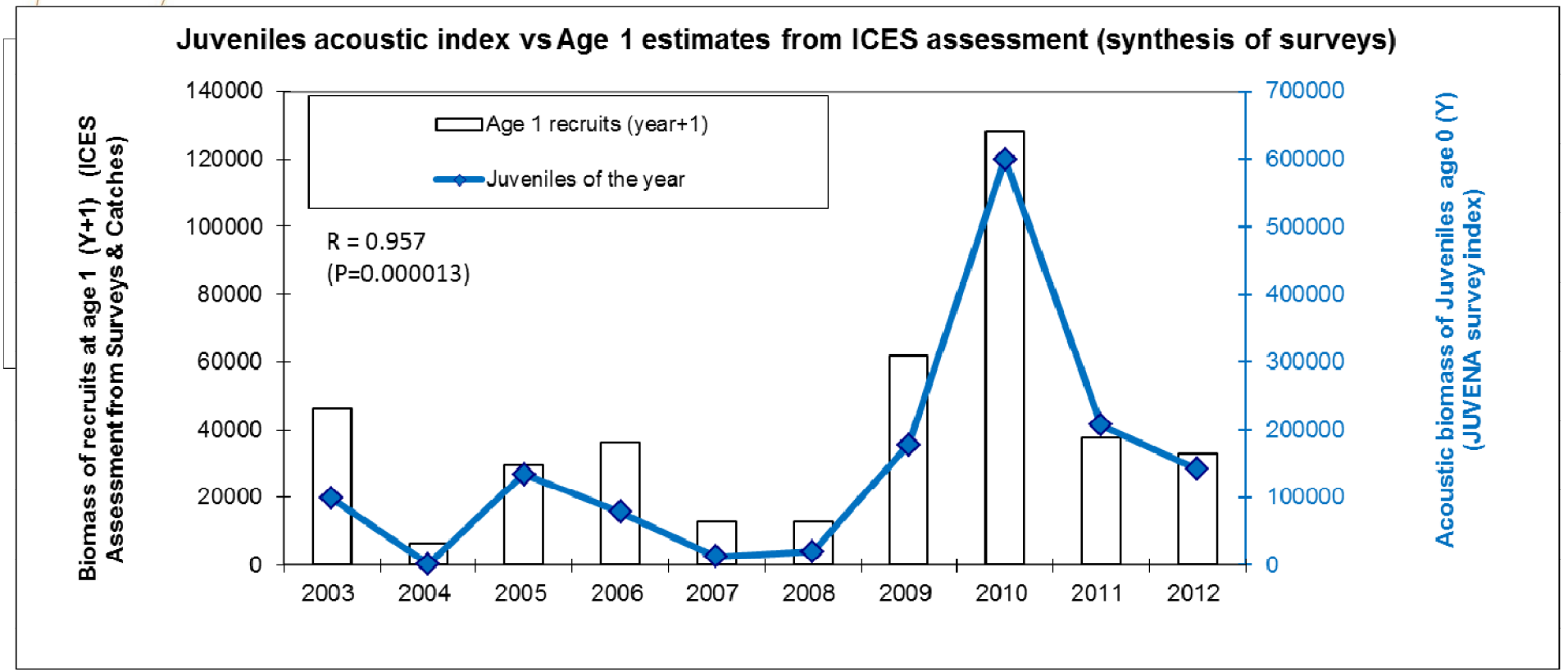
➔ The larger the increase in B the higher P1 R=0.722

Verifying with the international fishery : Correlation of successive age classes in the Catches (1987-2004)





Verifying: Consistency of Age 0 (Y) and Age 1 (Y+1) in Surveys



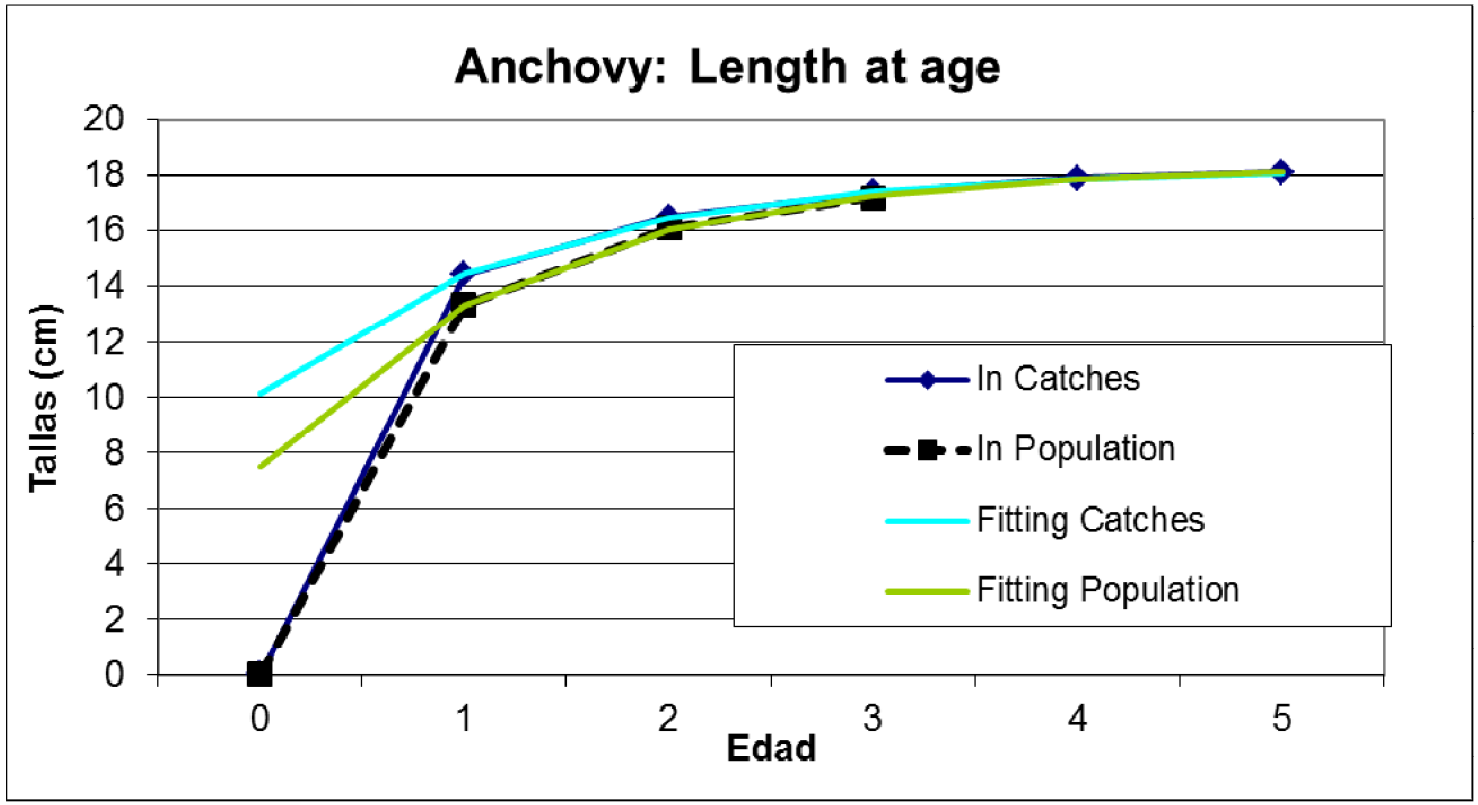
➔ Consistent survey estimates

➔ Good Age determinations of ages 0 and 1

Difficulties: Checks

➔ Knowledge of Annual growth pattern and typical cheks is required to avoid missinterpretations and overestimation of ages

Summary: Resulting Growth



Anchovy	In Catches	In Population
L inf.	18.30	18.3
K	0.75	0.8
t0	1.09	0.7

Summary Conclusions

- The methods is consistent with the population changes in length and biomassess (surveys) as well as in Catches

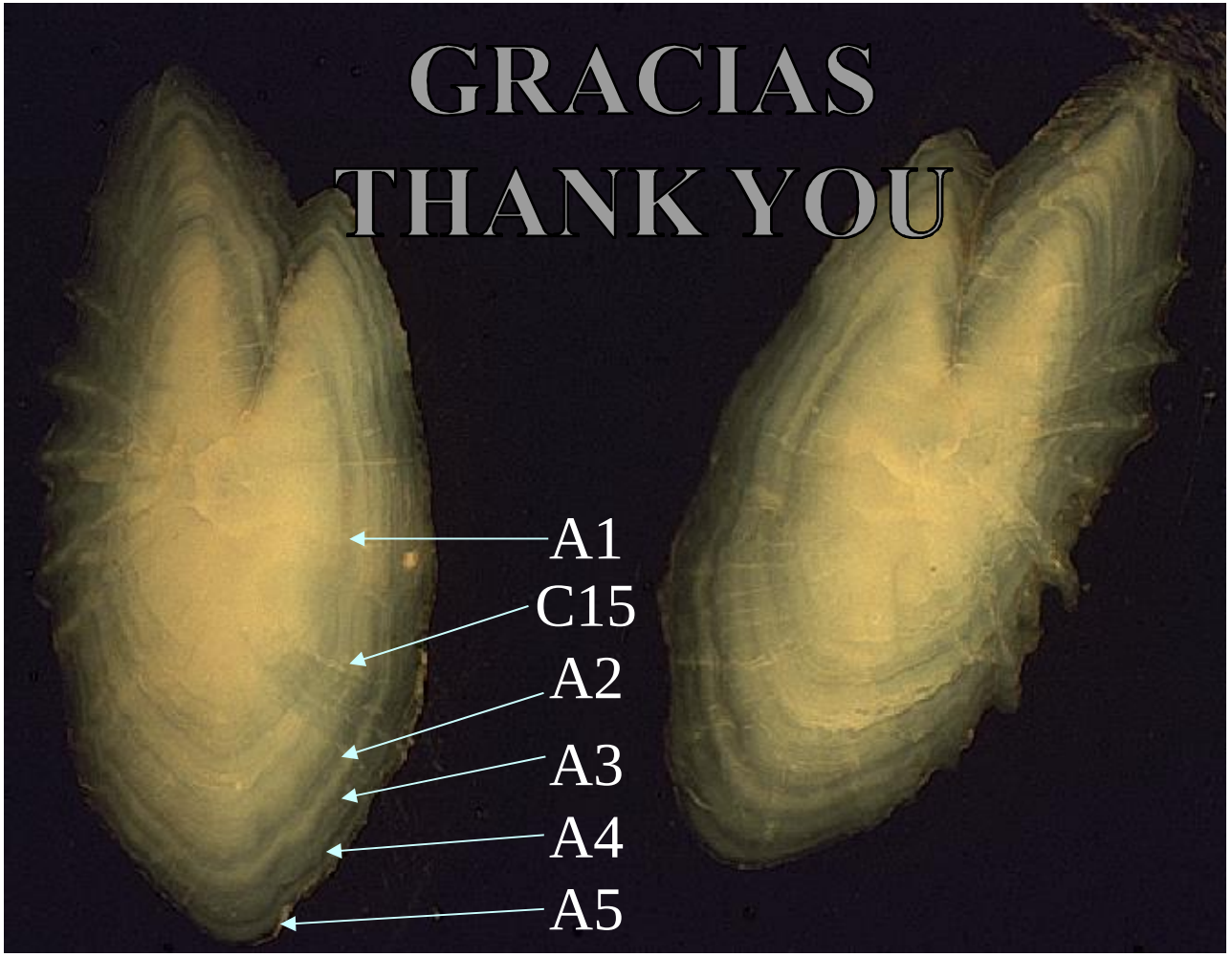
- The age reading method is based on the knowledge of date of capture and:
  - the annual growth pattern of the anchovy otoliths,
    - Criteria of complete growth zones: Age equals the number of complete opaque growth zones corresponding to the expected annual growth pattern of the otolith and excluding the marginal edge development of the year.
  - the seasonal otolith edge formation by ages:
    - maximum otolith opaque growth in summer months,

    The starting time of opaque edge formation changes with ages, being sooner at age 1 than at older ages. Edge should match expectationé

    in Spring: age 1 edge is opaque, while it is hyaline for older ages

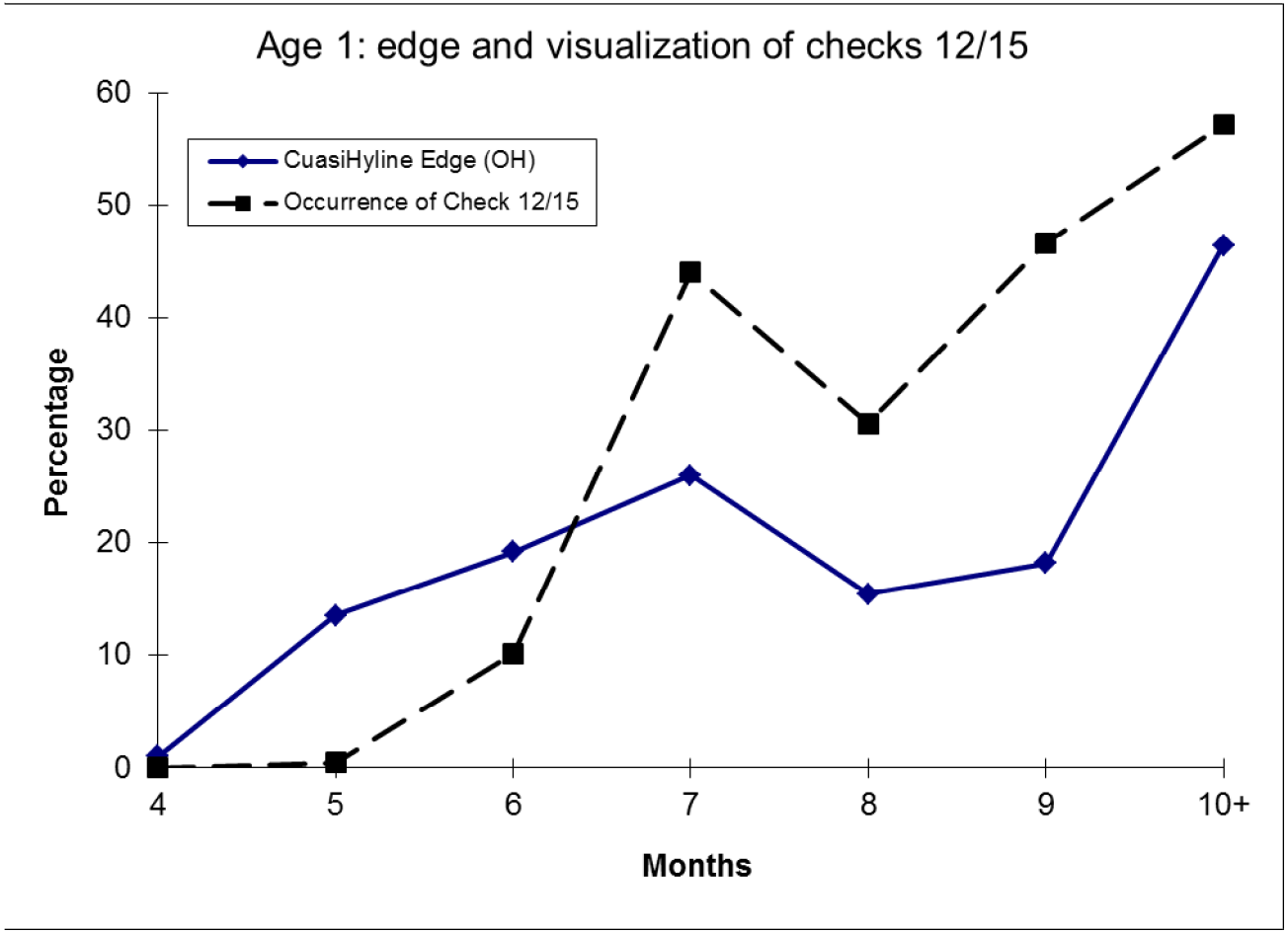
  - the most typical checks (C05-08 // C12-15)

END



Aknowledgements: to all institutions supporting the anchovy monitoring
Fisheries Department of the Basque Government
/ Spanish and French Fisheries Department and European Commision

Check 15: Spawning check?
Check 15 formed in July



➔ Check 12-15: A Likely spawning check

Between Readers Precission

- The age reading determination has been presented in workshops with colleagues of the Bay of Biscay area and other neighbour areas of South Europe in 1998 / 2002 / 2006 / 2009

- On average 93% of agreement among readers of the BoB
  - Average CV of 9.2%
- Better agreement for younger ages (0,1) than for olders (2,3, 4)

- More difficulties arise during the growing period of the year (summer): to discriminate between true winter rings from summer and autumn checks